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Patient-reported satisfaction and visual outcomes with scleral contact lenses in Indian keratoconus wearers

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Abstract

Objective: This study aimed to evaluate the comfort, visual outcomes, and overall satisfaction of keratoconus patients who transitioned to scleral contact lenses (ScCLs) from other lens modalities. It also explored the impact of ScCLs on dry eye symptoms and midday fogging.

Methodology: A total of 39 individuals diagnosed with keratoconus were enrolled after obtaining ethical approval and informed consent. All participants were habitual all-day wearers of ScCLs (17.0-18.2 mm in diameter) and had prior experience with at least one other contact lens type. Data were collected using a structured online survey administered via Google Forms after a minimum of three months of ScCL wear. The survey assessed patient-reported outcomes related to comfort, vision improvement, dry eye symptoms, and frequency of midday fogging.

Results: Of the 39 participants, 56.4% were female, with a mean age of 26.7 ± 3.2 years. Most (69.2%) had switched from corneal gas permeable lenses to ScCLs. A majority of respondents reported improved outcomes with ScCLs: 87.2% experienced superior comfort, 84.6% noted reduced ocular dryness, and 89.7% reported enhanced visual acuity compared to their previous lenses. Furthermore, 66.7% did not experience midday fogging, while the remaining 33.3% reported it with varying frequency.

Conclusion: The findings underscore the effectiveness of scleral contact lenses in improving both comfort and vision among keratoconus patients. Compared to other lens modalities, ScCLs provided superior visual stability, dryness relief, and patient satisfaction. Although some individuals reported midday fogging, it was a manageable issue that did not significantly detract from overall lens performance. These results highlight the role of ScCLs as a valuable and reliable option in the non-surgical management of keratoconus.

Keywords: Scleral contact lenses, keratoconus, contact lens comfort and dryness, midday fogging

Introduction

Keratoconus is a non-inflammatory, ectatic thinning disorder of the cornea that leads to progressive irregular astigmatism and distorted vision, thereby impairing visual function and quality of life-even in the early stages ^[1]. While spectacles may offer some correction in mild cases, they are often inadequate as the disease advances. In such cases, specialized contact lenses become essential for visual rehabilitation, with the primary goal being to enhance visual acuity without compromising corneal health.

A range of contact lens options is available for keratoconus management, including soft and soft toric lenses, rigid gas permeable (RGP) lenses, piggyback contact lenses (PBCL), hybrid lenses, and scleral contact lenses (ScCL) ^[2-5]. Soft spherical and toric lenses are generally limited to early keratoconus and may be prescribed in combination with spectacles, particularly in cases with high myopia or RGP intolerance. Corneal RGP lenses remain the initial lens of choice for visual improvement in many cases.

Specialized designs, such as Rose K lenses (Menicon Co., Ltd, Nagoya, Japan), are particularly effective for central nipple cones. These lenses feature smaller optical zones and multiple peripheral curves, allowing for a precise fit over steep cones while minimizing corneal contact and irritation. Their "feather touch" design improves both comfort and vision. Piggyback contact lenses (PBCL), involving an RGP lens placed atop a soft lens, are indicated for irregular corneas where RGP fitting is inadequate or in cases of RGP intolerance, instability, or lens ejection ^[6, 7]. Hybrid lenses, which combine a rigid centre with a soft peripheral skirt, are recommended for patients who experience poor centration, reduced wear time, or intolerance with RGP lenses ^[6, 8].

Scleral lenses represent an advanced modality for keratoconus management. These large-diameter lenses vault over the cornea and rest on the sclera, avoiding direct corneal contact. This design offers several advantages: a stable fit, reduced irritation, and a smooth optical surface. The lens also creates a fluid reservoir between its back surface and the cornea, maintaining hydration, protecting the ocular surface, and relieving symptoms of dryness—a common complaint in keratoconus exacerbated by prolonged lens wear^[9-11].

These attributes contribute to improved visual stability, enhanced comfort, and extended daily wear times, often exceeding 14 hours. Their secure fit also minimizes issues such as lens displacement or instability, allowing for uninterrupted participation in daily and physical activities. As a result, scleral lenses are often preferred by patients and are associated with high satisfaction levels, particularly in terms of visual clarity, dryness relief, and quality of life improvements^[12-14].

A unique drawback of scleral lens wear is Mid Day Fogging (MDF), caused by debris accumulation in the fluid reservoir, leading to temporary visual blurring. However, MDF is typically manageable through appropriate lens care, and its impact is outweighed by the substantial benefits scleral lenses offer in vision and comfort^[15-17].

Given their superior performance across key areas—vision correction, comfort, and dry eye symptom relief—scleral lenses consistently demonstrate higher patient satisfaction compared to RGP, PBCL, hybrid, and soft toric lenses^[3]. They have thus emerged as a preferred and reliable option for keratoconus management.

This study evaluates the comfort, visual outcomes, and overall satisfaction of keratoconus patients who have transitioned to scleral lenses after using other contact lens modalities. By analyzing patient-reported outcomes, this research highlights the subjective benefits of scleral lenses over traditional designs and explores their impact on dry eye symptoms, which significantly influence daily functioning and quality of life.

Materials and Methods

The study received ethical clearance from an institutional review board, ensuring full compliance with established ethical standards and research principles. All procedures were conducted in accordance with the tenets of the Declaration of Helsinki.

A total of 39 participants diagnosed with keratoconus were carefully recruited for this investigation. Informed consent was obtained from all participants following a thorough explanation of the study's purpose, methodology, and any potential risks involved. Participation was entirely voluntary, and individuals were informed of their right to withdraw from the study at any point without facing any adverse consequences.

Eligibility criteria required that participants have a confirmed history of keratoconus and be habitual all-day wearers of scleral contact lenses (ScCLs) ranging from 17.0 mm to 18.2 mm in diameter. Additionally, all participants were required to have experience with more than one previous contact lens modality. Prior to data collection, participants were educated about the characteristics and expected outcomes of ScCL use.

Data collection was conducted via a structured online survey distributed through Google Forms. This platform facilitated convenient and accessible participation, enabling respondents to complete the questionnaire at their own pace. The survey collected detailed information on participants' contact lens history, dry eye symptoms, and satisfaction levels after three months of continuous ScCL wear.

This methodological approach was designed to ensure transparency and foster trust between researchers and participants, thereby enhancing the reliability and validity of the study outcomes. To protect participant privacy, all responses were anonymised, and personal information was kept strictly confidential and used solely for research purposes. This commitment to ethical research practices helped create a supportive environment conducive to honest and accurate feedback.

Survey responses were manually entered into Microsoft Excel and analyzed using SPSS version 20.0 (IBM, NY, USA). Descriptive statistics, including frequencies, percentages, means, standard deviations, were computed.

Results

A total of thirty-nine participants were enrolled in this study. The majority were female ($n = 22$, 56.4%). The mean age of the participants was 26.7 ± 3.2 years, with an age range of 18 to 39 years. The average age at diagnosis of keratoconus was 17.2 ± 2.5 years. Of the participants, 25 (69.2%) had transitioned from corneal gas permeable lenses to scleral lenses, while 6 (17.9%) had previously used silicone hydrogel lenses. (Table 1)

Table 1: Demographic details of the participants ($n = 39$)

Factors	Results
Age (y), mean \pm SD (range)	26.7 \pm 3.2 (18 to 39)
Sex (n, %)	
Female	21 (56.4%)
Male	18 (46.1%)
Age (y), diagnosed with keratoconus, mean \pm SD (range)	17.23 \pm 2.5 (15 to 29)
Average wearing time (in hrs) of scleral contact lens, (range)	17 (10 to 19)
Previous lenses worn prior to scleral contact lens (n, %)	
Corneal GP	23 (58.9%)
Soft SiHy	6 (15.3%)
Piggyback	4 (10.2%)
Hybrid	6 (15.3%)

y = years, SD = Standard Deviation, n = number, % = percentage, hrs = hours, GP = Gas permeable, SiHy = Silicone Hydrogel

A total of 34 participants (87.2%) reported that scleral lenses provided superior comfort compared to their previous

lens modalities, supporting their effectiveness in the management of keratoconus. (Figure 1)

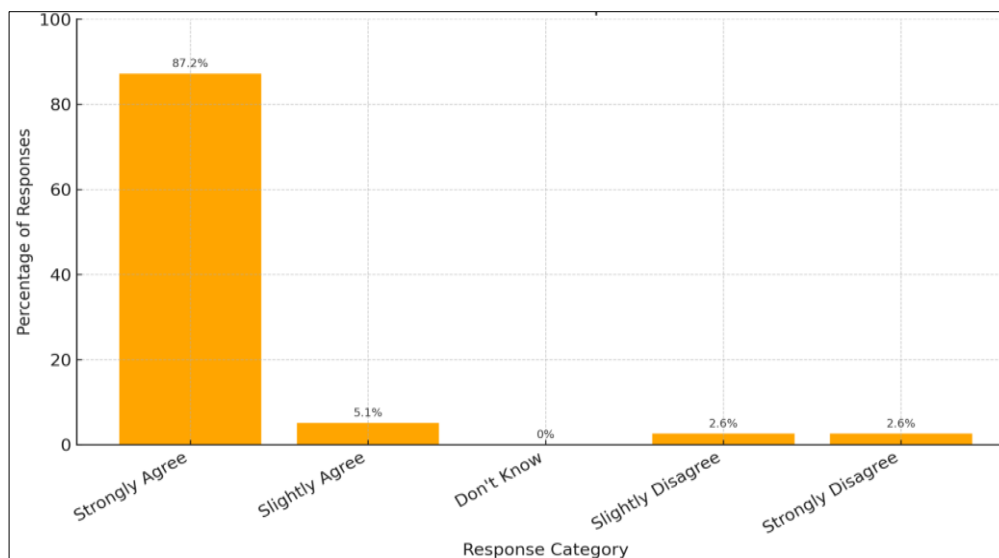


Fig 1: Comfort of current lenses to previous one.

Additionally, 33 participants (84.6%) indicated that their current scleral lenses caused less ocular dryness than their

previous lenses, suggesting a beneficial effect for individuals with dry eye symptoms. (Figure 2)

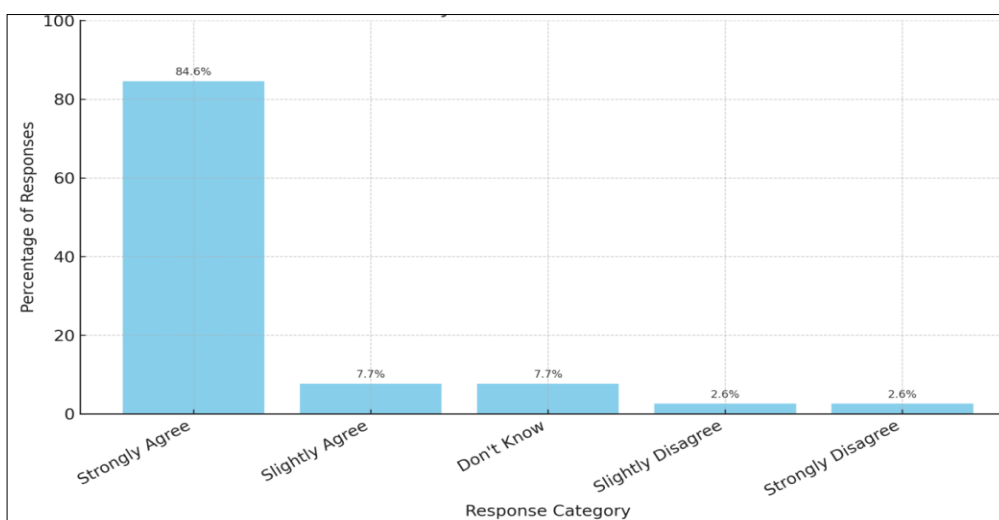


Fig 2: Perceived ocular dryness with current vs. previous lenses.

Furthermore, 35 participants (89.7%) strongly agreed that their current scleral lenses offered better visual acuity

compared to previous lenses. (Figure 3)

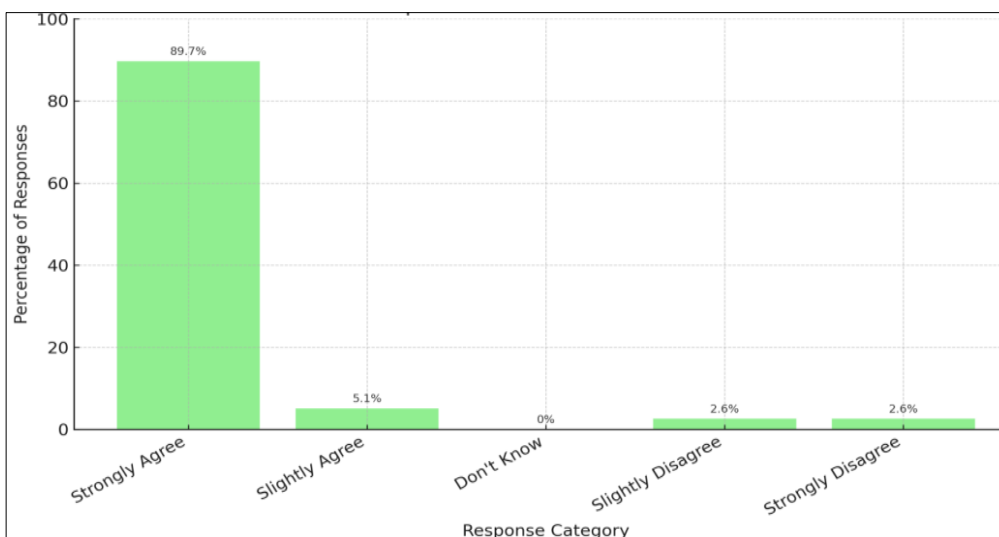


Fig 3: Perceived visual improvement with current vs. previous lenses.

Notably, 26 participants (66.7%) reported no experience of midday foggy vision (MFV), indicating improved visual

clarity, while 13 participants (33.3%) reported varying degrees of MFV. (Figure 4)

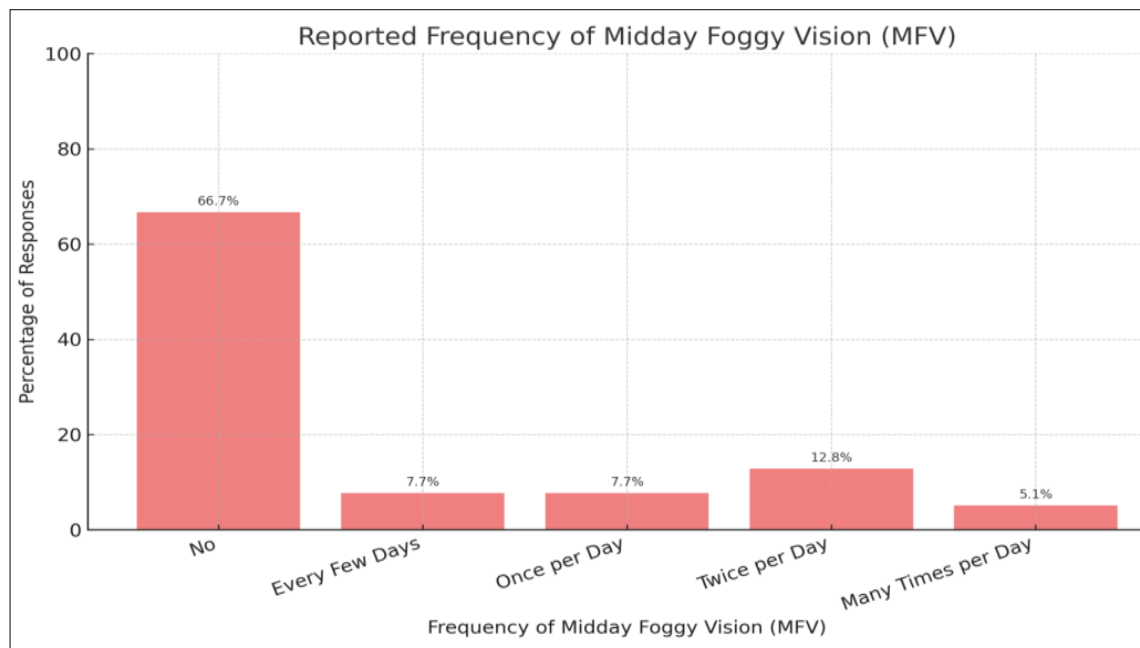


Figure 4: Reported frequency of MFV.

Discussion

This study offers valuable insights into the efficacy of scleral contact lenses (ScCLs) in managing keratoconus, particularly in terms of enhanced comfort and visual performance.

Visual Acuity and Comfort

Bergmanson *et al.* (2016) ^[1] reported that ScCLs significantly improve visual acuity in patients with advanced keratoconus, primarily by stabilizing the tear film and improving lens centration, thereby addressing irregular astigmatism and higher-order aberrations. In alignment with these findings, our study also demonstrated that participants consistently reported superior visual clarity with ScCLs compared to soft and corneal gas permeable (GP) lenses. Similarly, Radford *et al.* (2013) found that ScCLs provided better visual correction than other lens types in patients with moderate to severe keratoconus, a result echoed in our dataset.

Dumbleton *et al.* ^[4] further substantiated the superiority of ScCLs, highlighting their preference among patients due to enhanced lens stability and improved visual outcomes. Our results corroborate these observations, particularly noting that the larger diameter and vaulting design of ScCLs contribute to a more stable fit, reduced lens movement, and consistent optical performance. These structural advantages render ScCLs especially beneficial for patients who struggle with visual acuity using conventional, smaller-diameter lenses like corneal GP lenses.

In terms of comfort, Marella *et al.* ^[5] reported that ScCLs provide enhanced ocular comfort by resting on the sclera instead of the cornea, thereby reducing mechanical irritation and sensory stimulation commonly associated with corneal GP lenses. Our findings parallel this conclusion, as participants reported significantly better comfort with ScCLs than with their previous corneal GP lenses, particularly during extended wear.

Dry Eye Symptoms

An important observation in our study was the positive impact of ScCLs on mild dry eye symptoms. Although keratoconus is not typically associated with severe dry eye disease, the large-diameter design of ScCLs creates a fluid reservoir that helps maintain corneal hydration and reduces irritation. These outcomes align with those of Jones *et al.* ^[3] who demonstrated that ScCLs are particularly effective for patients with pre-existing dry eye, offering both protection and sustained moisture for the ocular surface.

Similarly, Dumbleton *et al.* ^[4] observed that ScCLs significantly improved comfort in patients with concurrent dry eye conditions, attributing this to the reservoir effect that maintains surface hydration. In our study, participants with underlying dry eye symptoms reported greater comfort and reduced irritation with ScCLs, compared to those wearing soft or corneal GP lenses. However, consistent with Jones *et al.* ^[3] patients without baseline dry eye disease did not report a substantial improvement in comfort, suggesting that the dry eye benefits of ScCLs are most notable in symptomatic individuals.

Midday Fogging (MDF)

One limitation noted in our study was the occurrence of midday fogging (MDF), a temporary reduction in vision due to particulate accumulation within the lens reservoir. Bergmanson *et al.* were among the first to identify MDF as a limitation of ScCL wear. Building on their work, our findings provided specific data on the prevalence and impact of MDF, revealing that a subset of patients experienced significant visual disruptions during the day, necessitating lens removal and reapplication ^[1].

This observation aligns with Radford *et al.* (2013), who acknowledged that while ScCLs offer substantial improvements in vision and comfort, MDF remains a concern for certain users ^[2]. Nevertheless, Marella *et al.* ^[5] argued that the overall advantages of ScCLs—namely enhanced comfort and visual quality—outweigh the

limitations posed by MDF. Our study supports this perspective, demonstrating that although MDF may reduce daily wearing time for some patients, it does not compromise the long-term effectiveness of ScCLs in visual rehabilitation.

Conclusion

The findings of this study demonstrate the effectiveness of scleral contact lenses (ScCLs) in improving visual outcomes and patient satisfaction among individuals with keratoconus. ScCLs provided superior comfort, stability, and visual clarity compared to other lens modalities, establishing them as a reliable option for managing this complex condition. Although some participants reported issues such as midday fogging (MDF), these were relatively minor when weighed against the overall benefits. These results highlight the pivotal role of scleral lenses in enhancing both visual performance and patient comfort, underscoring their importance in the comprehensive management of keratoconus.

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Conflict Of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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